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THE AMERICAN MATHEMATICAL MONTHLY

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THE MATHEMATICAL ASSOCIATION OF AMERICA

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SECOND SUMMER MEETING OF THE MATHEMATICAL ASSOCIATION OF AMERICA.

The second summer meeting of the Association was held by invitation of Western Reserve University and Case School of Applied Science at Cleveland, Ohio, on Thursday and Friday, September 6-7, 1917, in conjunction with and following the summer meeting of the American Mathematical Society. There were 90 persons in attendance at the various sessions, including the following 72 members of the Association:

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| O. P. AKERS, Allegheny College. | F. F. DECKER, Syracuse University. |
| FLORENCE E. ALLEN, University of Wisconsin. | R. M. DEMING, Case School of Applied Science. |
| R. B. ALLEN, Kenyon College. | L. W. DOWLING, University of Wisconsin. |
| L. D. AMES, University of Missouri. | JOHN EIESLAND, West Virginia University. |
| FREDERICK ANDEREGG, Oberlin College. | L. P. EISENHART, Princeton University. |
| R. C. ARCHIBALD, Brown University. | T. M. FOCKE, Case School of Applied Science. |
| G. N. ARMSTRONG, Ohio Wesleyan University. | TOMLINSON FORT, University of Alabama. |
| GRACE M. BAREIS, Ohio State University. | M. G. GABA, Cornell University. |
| I. A. BARRETT, Chicago, Ill. | D. C. GILLESPIE, Cornell University. |
| MRS. W. E. BECKWITH, College for Women,
Western Reserve University. | O. E. GLENN, University of Pennsylvania. |
| H. F. Blichfeldt, Stanford University. | C. F. GUMMER, Queen's University. |
| J. W. BRADSHAW, University of Michigan. | A. M. HARDING, University of Arkansas. |
| R. W. BURGESS, Brown University. | H. E. HAWKES, Columbia University. |
| W. D. CAIRNS, Oberlin College. | E. R. HEDRICK, University of Missouri. |
| FLORIAN CAJORI, Colorado College. | T. H. HILDEBRANDT, University of Michigan. |
| W. M. CARRUTH, Hamilton College. | WILLIAM HOOVER, Ohio University (Retired). |
| G. E. CARSCALLEN, Hiram College. | E. V. HUNTINGTON, Harvard University. |
| E. H. CLARKE, Hiram College. | W. A. HURWITZ, Cornell University. |
| G. R. CLEMENTS, U. S. Naval Academy. | R. A. JOHNSON, Western Reserve University. |
| BYRON COSBY, Kirksville (Mo.) State Normal
School. | O. D. KELLOGG, University of Missouri. |
| A. R. CRATHORNE, University of Illinois. | A. M. KENYON, Purdue University. |
| C. H. CURRIER, Brown University. | |

H. G. KEPPEL, University of Florida.

G. A. MILLER, University of Illinois.

W. L. MISER, University of Arkansas.

C. N. MOORE, University of Cincinnati.

F. R. MOULTON, University of Chicago.

H. L. OLSON, Chicago, Ill.

A. D. PITCHER, Adelbert College, Western Reserve University.

L. C. PLANT, Michigan Agricultural College.

S. E. RASOR, Ohio State University.

B. L. REMICK, Kansas State Agricultural College.

R. G. D. RICHARDSON, Brown University.

H. L. RIETZ, University of Illinois.

MARIA M. ROBERTS, Iowa State College.

E. D. ROE, JR., Syracuse University.

D. A. ROTHROCK, Indiana University.

J. E. ROWE, Pennsylvania State College.

C. A. SHOOK, Cambridge, Mass.

C. H. SISAM, University of Illinois.

P. F. SMITH, Yale University.

R. P. STEPHENS, University of Georgia.

E. B. STOUFFER, University of Kansas.

W. T. STRATTON, Kansas State Agricultural College.

C. F. THOMAS, Case School of Applied Science.

R. P. THOMAS, College of Wooster.

M. O. TRIPP, Olivet College.

T. O. WALTON, William and Vashti College.

D. T. WILSON, Case School of Applied Science.

B. F. YANNEY, College of Wooster.

J. W. YOUNG, Dartmouth College.

It is noteworthy that the attendance from the more distant parts of the country included one each from Alabama, California, Colorado, Connecticut, Florida, Georgia, Iowa, Maryland, New Hampshire and New Jersey; two each from Arkansas, Massachusetts, eastern Pennsylvania and Texas; three from Kansas; four each from Canada, eastern New York and Rhode Island; and five from Missouri.

The meetings began with a joint session of the Association with the American Mathematical Society on Thursday morning at nine o'clock. In the absence of Professor L. E. Dickson, president of the Society, President Florian Cajori of the Association called to the chair Professor E. R. Hedrick, ex-vice-president of the Society and ex-president of the Association. Professor L. P. Eisenhart of Princeton University read a paper prepared by invitation of the program committees of the two organizations, the subject being "Darboux's contribution to geometry." This address gave a clear and full analysis of the varied contributions to geometry of this noted mathematician who died last year. In particular Professor Eisenhart reviewed Darboux's work in the field of triply orthogonal systems of surfaces, of the deformation of surfaces and rolling of applicable surfaces, of infinitesimal deformation, of spherical representation of surfaces, and his development of the moving axes of coördinates. Special emphasis was laid upon Darboux's use of imaginary geometric elements, and in particular of isotropic cylinders and developables. The address will be published in the *Bulletin* of the American Mathematical Society.

The joint dinner of the two organizations was held Wednesday evening at the Hotel Statler and proved to be one of the most enjoyable of these periodical dinners, even though the attendance of seventy-seven was not so large as usual. Under the genial toastmastership of Professor Huntington speeches were made by the following: President C. F. Thwing, Western Reserve University; Professor T. M. Focke, Case School of Applied Science; Professor Virgil Snyder, Cornell University; Professor Florian Cajori, Colorado College; Professor W. C. Grau-

stein, Rice Institute; President E. E. Braithwaite, Western University, London, Ontario; Professor O. D. Kellogg, University of Missouri; Professor J. W. Young, Dartmouth College; Professor Tomlinson Fort, University of Alabama; and Professor F. R. Moulton, University of Chicago. After these somewhat formal exercises, the remainder of the evening was spent in social intercourse. Postcard greetings signed by those present were sent to our editor-in-chief, Professor Slaughter, who was unable to be present at the meeting.

On Wednesday afternoon between the meetings of the Society and those of the Association an organ recital was given in Amasa Stone Chapel by Professor Clemens, and an opportunity was afforded for a visit to the Cleveland Art Museum. President and Mrs. Charles F. Thwing entertained the members of the Association at a tea given at their home on Thursday afternoon at four o'clock. Particular appreciation was expressed by the ladies because of the arrangements provided for their comfort and entertainment by Mrs. W. E. Beckwith and Dr. Mary F. Curtis of the College for Women of Western Reserve University; this included an automobile ride about the city on Thursday morning. Luncheon was served each day at the Case Club in the immediate vicinity of the campus; this club with the convenient lounging room supplied a means of promoting that good-fellowship which is so important a part of the Association meetings. A formal resolution was adopted at the closing session, expressing the thanks of the Association to the authorities of Western Reserve University and of Case School of Applied Science for their invitation to hold the meetings at Cleveland; to all who assisted in making the stay in Cleveland so pleasurable, in particular to President and Mrs. Thwing for their hospitality, to Professor Clemens for his interesting recital, to those who made the arrangements for the visiting ladies, and to Professors Focke, Pitcher and Wilson who as local members of the committee on arrangements planned so effectively; and finally, to the program committee who under the chairmanship of Professor C. S. Slichter prepared so successful a program.

The sessions of the Association continued through Thursday morning and afternoon, and Friday morning, Professor Cajori presiding except for the last half of the session on Thursday afternoon, when he called to the chair Professor Keppel of the University of Florida. The sessions were all held in the lecture room of the Physics Building of Case School. The program and the abstracts of the prepared papers and discussions follow. It will be seen that the topics prepared by the committee for this meeting are well adapted to the needs of the average college teacher, and, as a natural result, the papers provoked much profitable and lively discussion.

At the close of the session on Friday Professor J. W. Young gave an informal report on the activity of the National Committee on Mathematical Requirements. No account of this will be given here since full and authoritative information from Professor Young will reach our members through a formal report to be printed in the November MONTHLY.

ORDER OF TOPICS ON THE SEPARATE PROGRAM.

- (1) "Undergraduate Mathematical Clubs." PROFESSOR H. E. HAWKES, Columbia University.
- (2) Discussion led by PROFESSOR R. C. ARCHIBALD, Brown University, and PROFESSOR D. A. RÖTHROCK, Indiana University.
- (3) Presidential Retiring Address: "The Significance of Mathematics." PROFESSOR E. R. HEDRICK, University of Missouri.
- (4) "Geometry for Juniors and Seniors." PROFESSOR E. B. STOUTER, University of Kansas.
- (5) Discussion led by PROFESSOR ARNOLD EMCH, University of Illinois, and PROFESSOR L. W. DOWLING, University of Wisconsin.
- (6) "The Treatment of the Applications in College Courses in Mathematics." PROFESSOR L. C. PLANT, Michigan Agricultural College.
- (7) Discussion led by PROFESSOR W. A. HURWITZ, Cornell University, and PROFESSOR A. M. KENYON, Purdue University.

Abstracts, numbered to correspond with the numbers on the foregoing program, are printed below, together with reports of some further informal discussions.

ABSTRACTS OF PAPERS.

(1) In speaking of undergraduate mathematical clubs Professor Hawkes first laid emphasis on the importance of such extra-curricula activities of college students as have to do with things of the mind. Although it is difficult for the average undergraduate to understand it, such activities express a deeper and more genuine loyalty to the college than athletics. After pointing out in some detail the benefits that members of a mathematical club might expect to derive from such an organization, he discussed various methods of organizing clubs. He thought that the particular type of organization made little difference provided some member of the faculty was able and willing to devote time and energy to the work of directing the students in the preparation of their papers, the outstanding fact being that the club will not run itself.

The latter part of the paper was devoted to types of topics, some of which are, and some of which are not, well adapted for presentation at the club by undergraduates.

(2) Professor Archibald gave an account of the Brown University mathematics club, whose organization, under the direction of a committee on arrangements and of a program committee, he explained. He then gave a number of facts concerning the organization of 26 undergraduate clubs whose location he indicated. The one at Smith College founded in 1899 was referred to as one of the oldest if not the oldest; and among the youngest were those founded during the past year at Alabama, North Carolina, Oklahoma, Oregon and Texas. In conclusion he spoke as follows:

"I wish to suggest that a special department of the MONTHLY be devoted to

undergraduate clubs. Probably forty clubs of this kind have been organized already and the increase in this number in the near future is sure to be rapid. There should be some connecting bond, some central source of suggestion, of interchange of ideas, and of inspiration. The MONTHLY has served as such an intermediary in the past, but it appears to me that much more might be done in the future. For instance, in each January issue might be published a list of the clubs with statistics as to membership and meetings. For future issues there would be a wealth of material to draw upon in lists of officers, programs and miscellaneous notes which might be procured from club secretaries. Then, too, such a special department would tend to draw out suggestions, discussions, papers and bibliographies for suitable program topics,—all contributing to the organization and development of these new forces, the undergraduate clubs, which are destined, I believe, in no small way to promote the cause of mathematics in America.”

Professor Rothrock gave a report upon the results obtained from a questionnaire sent to 160 colleges and universities of the United States. Only a very brief summary can be given here. There were 110 replies, 31 of which reported the existence of clubs with a total membership of about 900, ranging from 10 to 106 in the different institutions. Membership is, in general, invitational, but the door is open to practically all students above freshmen who are interested in mathematics. Most clubs are conducted by students with the coöperation of the faculty. The programs consist, for the most part, of topics from the history and pedagogy of mathematics, with some attention to the curiosities of mathematics; and, as well, addresses on topics of general interest to all by faculty members and invited guests.

Thirty of the clubs responding to the questionnaire have only the highest praise in favor of the club. According to these it is highly beneficial to the students in giving them opportunity to prepare and present in a public way the results of study, and it gives them insight into many phases of mathematics not otherwise treated in college courses.

In reply to an inquiry, Professor Roe described the mathematical fraternity, Pi Mu Epsilon, at Syracuse University. This club of about 55 members, which takes the place of the usual mathematical club, is a scholarship fraternity, the membership of which is made up from the best members of the higher classes. It was asserted to be a great stimulus both to students and faculty, the students doing better work in their courses in order to qualify themselves for membership. Professor Decker added that in an institution where fraternities abound, the Greek letter mathematical fraternity appeals strongly to the students' interest.

Professors Huntington and Fort described a mathematical club at Harvard University whose membership is confined entirely to advanced students, being dependent solely on their own inspiration and guidance and independent of any embarrassing or dampening effect due to the presence and criticism of faculty members. Messrs. Barnett and Clarke described briefly the mathematical clubs at the University of Chicago, Professor Dowling and Dr. Clements those at the

University of Wisconsin, and Professors Miller and Rietz those at the University of Illinois.

A large number of members took part in this discussion by way of inquiry or suggestion. Some of these related to membership fees (ranging from a simple annual fee of twenty-five cents for postage, etc., to a fee of three dollars to provide for "spreads"), limitations of numbers, voluntary *versus* assigned papers, measures to care for the passive students and to arouse discussion in the clubs, problem solving as an integral part of college work, and still other questions. The eagerness of inquiries and the equal readiness to share experiences made it very evident that the Association, through such conferences or through some still more effective means, can be of great service in bringing to many colleges and universities the benefits to be derived from the development of mathematical clubs. A symposium of these papers and discussions will be published in the MONTHLY.

(3) The presidential address of the retiring president, Professor E. R. Hedrick, dealt with the significance of mathematics in several phases. As an offset to recent criticisms of mathematics, the essential necessity of a widespread knowledge of quantitative relations, as revealed by the existing war, was emphasized. It was urged that the Association might be a center for increasing the appreciation of mathematics of collegiate grade. Finally the recognition of applied mathematics by the Association was mentioned, and the possible function of the Association in stimulating work in applied mathematics was emphasized. The paper will be published in full in an early issue of the MONTHLY.

(4) In his paper on "Geometry for Juniors and Seniors" Professor Stouffer first discussed the need of a course in geometry for juniors and seniors, and then considered some general principles which he believed to be essential to the proper selection and arrangement of the material for such a course. A brief outline of a course in projective geometry was then given which should couple together the earlier courses in geometry and form an introduction to advanced courses which might be taken. This paper will be published at an early date in the MONTHLY.

(5) Professor Emch agreed with Professor Stouffer in the most important points. His principal postulate in his comment was that much more attention should be paid than at present to the constructive side of elementary geometrical instruction with the use of various geometrical instruments. He added that instruction in geometry should run parallel with instruction in algebra. He differs from Professor Stouffer in placing less emphasis on the synthetic as opposed to the analytic side, and in contending that the pupil in a first course in projective geometry should be enabled to solve graphically problems in perspective or central projection rather than to reason successfully on the abstract parts of the subject, the latter being reserved for a second course.

Professor Dowling found himself in substantial agreement with Professor Stouffer's paper. He objected to the vocational *raison d'être* for mathematics in general and for geometry in particular, but wished to emphasize the constructive side of projective geometry on the important ground that prospective

teachers of geometry need training in the power of visualization. He felt that the proposed outline of topics for a course in projective geometry placed the discussion of conics and the consequent construction work too far along in the course. He preferred to follow Reye in this particular, even if the removal of analytic discussion proposed by Professor Stouffer necessitated a postponement of the consideration of continuously projective forms until a later chapter. He emphasized particularly one point of the main paper in saying that the greatest cultural value of projective geometry arises from a study of the generalizing methods and principles characteristic of modern work in geometry.

In the extension of this discussion Professor Hedrick urged that geometry should be studied in this country more than is now the case; Professor Eisenhart called attention to the later volume of Darboux on the principles of analytic geometry which presents the advantages of coördinate systems, a discussion of the geometry of Cayley, and of transformations by inversion, a book which could very properly be used with juniors; Mr. Barnett mentioned a recent Italian text organized somewhat along the lines of Professor Stouffer's course; Professor P. F. Smith pointed out that later college courses in mathematics need not be justified in the way necessary with earlier courses, that the aim in projective geometry might very well be to interest the student and to prepare for his future courses; and Professor Huntington remarked that the treatment of imaginary elements must depend not on visualization but on analytic means.

(6) Professor Plant in his paper on the "Treatment of the Applications in College Courses in Mathematics" pointed out that it would first be necessary to consider why applications, other than a limited number of a geometrical character, should find any place at all in college courses in mathematics. He showed that varied applications are justified if by their use the teacher can (1) arouse an interest in the subject by bringing out its beauty through geometry, or by emphasizing its utility through mechanics; or (2) clarify the fundamental ideas that underlie the subject through geometry, physics, or mechanics; or (3) can more effectively put the student in possession of a powerful instrument for the development of the exact sciences. He also pointed out that the kind of students for whom the applications are written must be kept in mind. Students who elect courses in pure mathematics find pleasure in the logic of the treatment. The majority of students, however, belong to that class who take mathematics because it is a means to an end, and for this class applications will prove of interest only if the student is properly prepared to handle them.

After a discussion of the assumptions made by different teachers and authors concerning the preparation of the student, the conclusion was reached that it is not safe to base the treatment of applications upon ideas and principles which are likely to be outside the student's general experience. Since also instructors are quite prone to think that whatever amount of information the text may contain is sufficient for their classes, it follows that the preparation for the particular applications must be supplied by the author if he wishes to be certain that his readers are prepared to understand them. This, of necessity, reduces

the number of applications he can use and still keep his text within reasonable limits. For this reason, as well as for others, applications should be so selected and treated that they become an integral part of the course, the application bringing out more clearly certain mathematical principles and concepts and at the same time the mathematics appearing to have been created for the application.

The use of a certain kind of problem to supplement, but not to be substituted for, the applications just outlined was emphasized. Such problems may be selected from physics, chemistry, or mechanics, and are stated in the form of assumptions. Since they are so stated the student can work them, even though he does not appreciate their physical significance. While these problems serve to familiarize the student with a type of work actually encountered in the sciences, their greatest value comes from the fact that they furnish assumptions which appeal to the student's interest.

(7) [Both the speakers announced for the discussion of this paper, Professors Carver and Ling, were unable to be present because of serious illness in their families. Professors Hurwitz and Kenyon kindly consented to supply these places on the program, and their discussions, though given on brief notice, were highly appreciated.]

Professor Hurwitz, mentioning two frequently considered reasons for teaching applications in courses in mathematics, namely, the promotion of the student's interest in the subject and the clarification of mathematical principles, emphasized as an important third reason the value to cultural students of such applications as ends in themselves. He deprecated the use of many problems based on concepts neither belonging to the student's normal experience nor admitting of ready explanation to him; for such questions as rest on ideas not in the student's experience, it is advisable to state the general laws involved with brief explanation, clearly marking the distinction between the assumptions and the mathematical deductions. He warned against insistence on pseudo-rigor in the treatment of applications in elementary courses. In concluding, he pointed out the value and the practicability of requiring the students to make problems for themselves, as well as to gather them from the abundant sources of puzzle-supply in the newspapers and magazines.

The primary reason for the use of applications in college courses in mathematics, in Professor Kenyon's opinion, is to give the student an insight into the meaning and implications of the fundamental principles of mathematics. Applications treated under the guidance of this principle are a strong stimulus to the interest of the student. Professor Kenyon has scant regard for courses in which the applications rather than the mathematical principles determine the material, arrangement, and method of presentation. In case of students in scientific and technical courses, a second reason for treating applications is to develop and exercise the ability of the student to make similar applications for himself in subsequent studies and work. To do this independently and confidently requires a certain attitude and maturity of mind which results, if at all, from a somewhat extensive experience and drill in the field of mathematical and scientific ideas,

to which it is one function of the mathematics instructor to contribute as much as possible. On the other hand it is, and ought to be, hopeless to attempt to prepare the technical student for his future work by trying to show him how to make all the applications that are likely to confront him in the future.

MEETING OF THE COUNCIL OF THE ASSOCIATION.

The Council met at five o'clock Thursday afternoon.

(1) The following nine persons and two institutions, on applications duly certified, were elected to membership.

To individual membership:

ELBERT ALLEN, Superintendent and instructor in mathematics, High School, Bainbridge, Ind.

FLORENCE E. ALLEN, Instructor in mathematics, University of Wisconsin, Madison, Wis.

CHESTER C. CAMP, Professor of mathematics, Ottawa University, Ottawa, Kan.

GUY R. CLEMENTS, Instructor in mathematics, U. S. Naval Academy, Annapolis, Md.

MARION CONNELLY, Graduate student, University of Chicago, Chicago, Ill.

JOHN H. MINNICK, Instructor in mathematics, University of Pennsylvania, Philadelphia, Pa.

SAMUEL S. PENN, Brooklyn, N. Y.

EARLE B. PHELPS, Professor of chemistry, Hygienic Laboratory, U. S. Public Health Service, Washington, D. C.

SHELTON P. SANFORD, Athens, Ga.

To institutional membership:

UNIVERSITY OF ARKANSAS, Fayetteville, Ark.

UNIVERSITY OF NEBRASKA, Lincoln, Neb.

This is the proper place to publish a list of thirteen persons and two institutions elected to membership by mail vote of the council in July, 1917:

To individual membership:

EARL J. BELCHER, Instructor in mathematics, Broadus Institute, Philippi, W. Va.

A. C. BOSE, Deputy magistrate, Bengal provincial civil service, Simla, India.

WILLIAM E. HEAL, Efficiency accounting, Washington, D. C.

LOUIS E. MENSENKAMP, Instructor in mathematics, High School, Freeport, Ill.

VICENTE MILLS, Surveyor, Bureau of Lands, Manila, P. I.

OSCAR A. RANDOLPH, Instructor in physics, University of Colorado, Boulder, Col.

ALBERT A. RILEY, Washington, D. C.

PAULINE SPERRY, Assistant professor of mathematics; Smith College, Northampton, Mass.

H. IVAH THOMSEN, Baltimore, Md.

ROSS B. WILDERMUTH, Assistant professor of mathematics, Capital University, Columbus, Ohio.

EDNA F. WILSON, De Smet, South Dakota.

JAY W. WOODROW, Assistant professor of physics, University of Colorado, Boulder, Col.

CHIA-CHEOW YEN, Professor of mathematics, Chinese Government Engineering College, Tangshan, China.

To institutional membership:

CULVER-STOCKTON COLLEGE (formerly Christian University), Canton, Mo.

UNIVERSITY OF PORTO RICO, Mayagüez, P. R.

(2) The Council having voted at the New York meeting that the winter meeting of the Association should be held in Chicago in conjunction with the Chicago Section of the American Mathematical Society, the determination of the exact dates for this meeting was referred by the Council to the joint committee on arrangements, the composition of which, as also of the program committee, is to be announced by President Cajori after consultation with the proper authorities of the Society.

(3) Certain contemplated plans which concern the editorial care of the MONTHLY and a proposal to change the manner of choosing the secretary-treasurer are to be communicated to the whole Council and then laid before the members through the columns of the MONTHLY, in accordance with the provisions of the constitution concerning amendments to the constitution or by-laws.

(4) Measures for taking care of certain expense in the collecting of data for the National Committee on Mathematical Requirements were referred with power to the Committee on Finance of the Council.

(5) A plan for a mathematical dictionary, suggested in the main by Professor G. A. Miller, was brought by him before the Council. It was agreed that the plan, if it can be carried out, is so important and that the questions of the various details, as to size, cost, extent, etc., are so involved, that a committee of five should be appointed by the president, to make an extended study of the plan, and to report to the Council.

W. D. CAIRNS, *Secretary-Treasurer.*

ALGEBRA COURSES FOR COLLEGE JUNIORS AND SENIORS.

Edited by U. G. MITCHELL, University of Kansas.

At the fourth meeting of the Kansas Section of the Mathematical Association of America a large part of the program was devoted to the consideration of